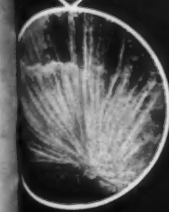


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* Paper from the International Conference on the Peaceful Uses of Atomic Energy.

Editorial:
We'll Follow the Sun
Inside Front Cover

50¢

We'll Follow the Sun

► IN THE SEARCH for ways to trap the energy of sunlight to power our mechanical civilization, the world may again see some of the great population shifts which have occurred from time to time as mankind has settled one new area after another on our globe. Although no doubt fortunes will be made in today's thickly populated temperate zones on inventions using the sun's priceless fuel, the present drive toward use of solar energy comes from fear of looming poverty.

Long before man appeared on this planet, the sun's energy was invested in growing a great quantity of plant life. The carbon compounds locked up in these plant structures accumulated to form treasure hoards in underground deposits of coal and oil. Millions of years' accumulation of this treasure has been tapped to fuel our high-energy civilization, but in less than two centuries we have nearly used it up. While it is true that some oil is forming daily, this drop-in-the-bucket rate is not going to save us from a change in our way of living.

With the ingenuity already developed by experience in building machines to use fossil fuels, and whetted by the recent applications of nuclear energy to producing useful power, mankind will probably solve the problems inherent in use of solar energy before our heritage of fossil fuel runs out. As soon as sunshine-using devices become at all practical, the ancient semi-tropical river valleys where civilization first began will probably see a new spurt of immigration by gadget-minded people. They will build air-conditioned houses, grow crops by the most efficient photo-synthetic methods, and cook their main meals while the sun shines. They will be sure their ways are the embodiment of progress.

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► SOLAR ENERGY devices displayed in Phoenix, Arizona, on the grounds of the public library attracted a continuous line of visitors who wanted to learn how to put the desert sunshine to work. The exhibit was held in November in conjunction with the first World Symposium on Applied Solar Energy.

Power From the Sun?

By HELEN M. DAVIS

► THE SUN'S heat melts metals but will not bake bread.

The sun's energy is free but too expensive to use.

Sunlight can be used to generate electricity but the sunpowered storage battery is yet to be invented.

Scientists have by long and diligent work puzzled out all but the earliest, most essential step in photosynthesis, but the lowliest

one-celled bit of green scum in a roadside ditch has known it all the time.

Mankind can solve the problem of feeding the world's fast-growing population by eating these one-celled green ditch-water plants, but beefsteak tastes better.

Such are the dilemmas of solar energy, tackled from the standpoint of practical application by the world symposium on applied

JANUARY, 1956

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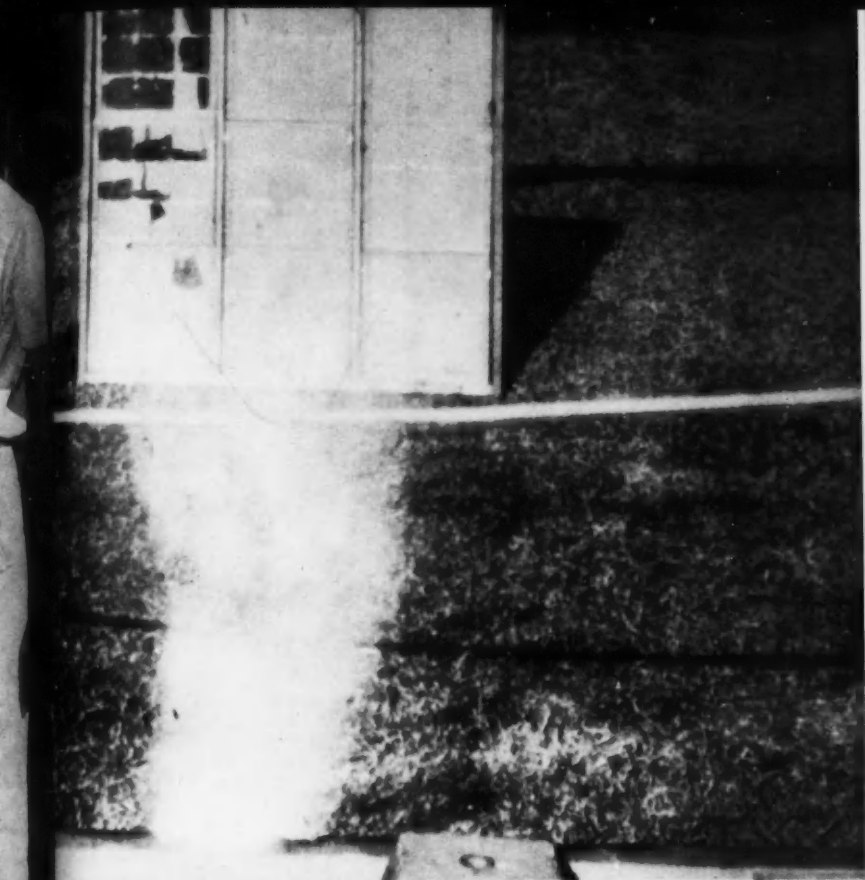


► AN UMBRELLA FRAME was adapted to make a backyard solar cooker by George O. G. Löf, engineer, of Denver, Colorado. Its use to boil water and broil frankfurters was demonstrated by Edwin Reinbold, a guide at the Phoenix, Arizona, Solar Engineering exhibit.

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► THE FOCUS of the sun's rays makes a very hot spot which sets fire to a piece of wood in a few minutes. Small curved plates in this frame act together to concentrate the sun's heat and set fire to the board several feet away.

solar energy. Burning-glass lenses, paraboloid mirrors and improved cold frames concentrate sunlight, electronic guiding mechanisms hold the sun's image steady while the earth turns, architects rede-

sign roofs to catch both summer and winter sunlight, refrigeration engineers plan heat sinks to cool buildings in summer, warm them in winter by sunshine and store excess for use on rainy days.

JANUARY, 1956

3

solar
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hibit.



➤ A FOLDING solar cooker easy to carry and to set up as a standard paraboloid reflector was shown by its designer, Adnan Tarcici of Beirut, Lebanon. His country, where fuel is scarce and the sun shines a large part of the year, is interested in practical use of solar cookers.

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Successful applications of these principles were viewed by scientists at the solar engineering exhibit in Phoenix, Arizona, in November. In Tuscon, at the earlier conference on solar energy, they had shared theories, plans and experience of solar energy to meet world-wide problems of food, water, fuel and power shortages.

The first impression evident to the observer at the solar energy exhibit was that the machine age is taking a new direction. Efficiency is being sacrificed to simplicity in design of solar engines.

Faced with actual shortages of fuel now in many parts of the world and potential shortages in future time measured only in decades, scientists find comfort in the abundance of energy pouring down from the sun. They can afford to waste a good deal of it while concentrating on cheap construction and easy operation. Old designs, bypassed in development of the internal combustion engine, are being dusted off and are often found promising for the new requirements. Distinctions are being drawn between what cannot ever be done and what has not been done yet.

Needs to be met are pumped water for irrigation of desert lands, distillation of fresh water from the sea, combined installations to heat houses in winter and cool them in summer, solar cookers for use where no fuel is avail-

able, production of power with sunlight substituting for fuel in conventional heat engines and creation of electrical energy directly from chemicals through the aid of the sun.

Unsolved problems challenging scientists in the solar energy field are: better collection methods to concentrate diffuse sunlight for production of higher temperatures, electrical or chemical means for storing energy developed by sunlight, improved machine designs for the special conditions where solar energy will do the most good. Restrictions expressed as the Carnot cycle and the second law of thermodynamics limit machine design, but offer challenge to ingenuity.

As the source of life on earth, the sun controls photosynthesis. Some scientists believe the solution to a diminishing food supply problem will come from algae, one-celled plants used for photosynthesis studies. Dr. Hiroshi Tamiya, Tokugawa Institute for Biological Research, Tokyo, recommended chlorella algae for food and feed supplements, and passed around samples of the dark green powder made from them. Its slightly fishy taste is reported pleasing to the fish-loving Japanese taste.

Solar "Roof" Measures Energy

➤ THE SUNNY world has a new "roof," the covering of usable energy which the sun lays down

on the surface of the earth on an average clear day.

"Roof" is the new unit, described as the quantity of sunlight energy which would fall on the actual roof area of a small house, about 33-foot square, during a day when the sun shines at the rate of a million calories per minute. Dr. Farrington Daniels, University of Wisconsin chemist, proposed this unit to measure useful sunshine at the solar energy conference.

Like a ton of coal, a gallon of gasoline or a gram of uranium, the "roof" measures the usable energy, in the form of heat to cook food, heat water or power a heat pump for cooling or freezing. With eight hours of sunshine, a "roof-day" of solar energy would provide as much heat as would the burning of a man's weight of coal or of the gasoline in the fuel tank of a small automobile.

Use of this quantity of sunshine to furnish the small-scale power needs of the world, for heating houses, for pumping water, for preparing food, was the goal of the scientists and engineers who attended the symposium, sponsored by the Association for Applied Solar Energy.

"Solar energy is primarily for the countryside, not for the cities," Dr. Daniels pointed out, praising the sunshine and the open

spaces in Arizona. But he noted that sunshine in any one locality falls evenly on high-priced city real estate and on waste-land which is now nearly worthless. Practical ways to use this abundance of energy might shift the centers of population to sunnier climates.

Dr. Daniels cautioned against expecting too much fulfillment of the present interest in solar energy too soon. He stated that realization that fossil fuels are definitely limited has stimulated people in countries like the United States to look for eventual replacements of coal and oil. It has also stimulated people in countries poorer in these natural resources to seek substitutes obtainable from the sun's heat. Cheapness and simplicity are among the advantages of solar power plants. They require only thousands of dollars investment, instead of millions.

"Unlike atomic energy," Dr. Daniels stated, "solar energy has no critical mass, no health hazards (except sunburn), and no waste products to dispose of. Anyone can go out in his yard and run a toy steam engine with free sunshine."

How to enlarge the toy steam engine to a useful power plant was the purpose of this gathering of the world's scientists.

Mystery of Drugs From Plants

► HERE'S a mystery that science has not yet solved: why do certain plants manufacture compounds which they apparently do not use, but which are important in a medical way to human beings?

According to Dr. Edward Leete, University of California at Los Angeles chemist, these compounds are alkaloids, which include morphine, atropine, strychnine and nicotine.

It has been suggested that these compounds are waste products. But Dr. Leete, who has been studying them for several years, says their chemical complexity seems to rule out such an ignominious role.

It has also been suggested that plants use toxic alkaloids to protect themselves from insects. Several of the compounds are used in insecticides. But many of the compounds are not toxic enough for the job.

Plants that produce the substances seem to get along very well without them. For example, tobacco plants, which produce nicotine in their roots, when severed from their roots and grafted to a tomato plant, thrive without a trace of nicotine.

The understanding of the way

in which these compounds arise in nature may fill in some missing link in our knowledge of life processes, Dr. Leete says.

Cortisone From Rare Yams

► THE MANUFACTURE of cortisone may be greatly simplified with the isolation of two new chemicals found in rare Mexican yams, the U. S. Department of Agriculture reports.

The two compounds are described as the best ever found in nature as raw materials for making the arthritis-relieving drug. They were isolated from the yam's tubers by chemists at the Department's Eastern Utilization Research Branch in Philadelphia.

Discovery of the rare plant in remote southern Mexico climaxed several years search for the yam. Persistent rumors that such a plant with the desired chemicals existed had sent plant explorers looking for it time and again. Chemists were beginning to doubt the substance's existence when Drs. H. S. Gentry and D. S. Correll of the USDA found the plants.

The two plant explorers were honored for their find by having the chemicals named for them, gentrogenin and correllogenin.

The chemicals were isolated by Henry A. Walens, Samuel Serota and Monroe E. Wall.

In describing the importance of the discovery and isolation, Dr. G. E. Hilbert, director of utilization research, said that the newly discovered plant chemicals are potentially much better as starting materials for the manufacture of cortisone by chemical means than any other naturally occurring substance now known.

The major source of chemicals for making cortisone at present is ox bile. The unusual value of the yam's chemicals, scientists point out, is that each chemical contains two desirable chemical structures. Ordinarily, only one such structure is found in nature.

Samples of the yams were also shipped to the Department's plant-introduction garden at Glenn Dale, Md., for field tests. If they can be cultivated, they may prove to be an economical source of the raw materials needed for cortisone manufacture.

Mental Disease Antidote?

➤ A DRUG that may be an antidote for anxiety and mental disturbances in some cases has been discovered.

It acts as an antidote to certain chemicals naturally manufactured in the brain. Too much of these chemicals or too little resistance to them may help bring on anxiety and abnormal mental states, particularly in the elderly.

The drug is a piperidyl chemical trade named Frenquel. It has already been reported as promising for treating mental disease.

Research showing that the drug "begins to acquire the characteristics of an antidotal action" was reported at the Gerontological Society meeting in Baltimore. The report was given by Dr. Amedeo S. Marrazzi of the Army Chemical Center, Edgewood, Md., of studies by himself and his associate, Dr. E. Ross Hart.

They studied the effects of drugs on nerve centers called synapses which Dr. Marrazzi explained as switchboards of the brain and central nervous system. As in other communicating systems, these are both the strategic and the most vulnerable portions.

Some chemicals stop transmission of nerve messages by blocking the switchboards, the Army Chemical Center scientists found. This can result in abnormal mental states.

One chemical acting in this way is mescaline, a powerful drug first used by the Plains Indians to achieve intoxication during religious rites. Mescaline is known to produce anxiety states in humans as well as hallucinations.

A chemical found in the brain, serotonin, also blocks the nerve switchboards, the scientists found. Serotonin is about 1,500 times as powerful as mescaline. Dr. Mar-

razzi said it may be of the highest importance in naturally occurring anxiety and in human mental disturbances.

Frenquel and the tranquilizing drug now widely used in mental disease, chlorpromazine, block the action of mescaline on the nerve switchboards. Chlorpromazine stops anxiety but does not affect other mental aberrations.

Frenquel not only blocks anxiety but also in some cases the attending hallucinations. It therefore is more than a tranquilizing chemical. Dr. Marrazzi sees it as an antidote to the chemicals that block the switchboards.

Sedative drugs such as the barbiturates depress nerve message transmission through the nerve switchboards. This eliminates anxiety by impeding transmission but the change, although helpful, is not a change toward normal.

Frenquel, on the other hand, overcomes the switchboard blocking action of mescaline, and presumably of serotonin also, without depressing the switchboard unless 20 times the necessary dose is given.

A question raised by the studies

is whether anxiety and mental disturbances in the aged come because of too much serotonin being made or because aging makes the nerve switchboards more vulnerable to this chemical.

Nicotine Relative

➤ A RELATIVE of nicotine is now being tested to determine what effect it may have on cancers.

The chemical is 6-Aminonicotinamide. The tests are being made by Drs. Willard J. Johnson and J. D. McColl of the research laboratories of Frank W. Horner, Ltd., in Montreal.

This chemical is a potent antagonist to nicotinamide, better known as anti-pellagra B vitamin, niacin.

The idea of its having anti-cancer possibilities comes from finding that it acts on DPN, short for diphosphopyridine nucleotide. DPN is a vital chemical in the nuclei of body cells. The 6-Aminonicotinamide apparently inactivates DPN in some cells. If it could do this in cancer cells, and could be given in a way to restrict it to cancer cells in the body, it might become an anti-cancer chemical.

Ten thousand pounds more tomatoes an acre, an average increase of 12% in fruit size, has been reported in fields sprayed with a mixture of streptomycin and terramycin to control the costly disease, bacterial spot.

Ships can be protected from radioactive contamination by a heavy washing down with salt water, it is believed, and all new British warships will have equipment to accomplish the wash-down.

Chemicals Aid Heart and Brain

► PATIENTS dying of severe heart disease may have been undernourished, lacking particularly vitamin B one, or thiamine, suggests the editor of *Nutrition Reviews*.

The hint of this B vitamin lack is based on recent postmortem studies in which the vitamin content of the heart muscle was measured.

Less of the vitamin was found in the heart muscle of 12 patients who died of heart failure with signs of various kinds of organic disease than in heart muscle of 10 patients without heart disease who died of other causes. The differences, moreover, were consistent, with no over-lapping between the two groups.

Whether the lack of thiamine was enough to impair the vital chemical processes in the heart muscle is not known. Thiamine is known to be important for this, and the finding of thiamine deficiency suggests the vitamin lack may have harmed the heart muscle chemical processes.

Anti-Clot Drugs For Strokes

► HOPE OF preventing strokes of apoplexy by anti-blood clotting drugs now used for some heart patients appeared in a recent re-

port to the American Heart Association.

A "striking decrease in mortality" followed this treatment in 53 carefully selected cases, Drs. Robert G. Siekert and Clark H. Millikan of the Mayo Clinic, Rochester, Minn., reported.

The mortality in this group was 14% compared to 43% in a similar group that did not get the anti-clot treatment.

The treatment would be for those in whom certain warning signals suggest a clot is forming that may eventually obstruct a major brain artery.

Many strokes, however, are caused by a rupture of weakened blood vessel walls in the brain. The anti-clotting drug cannot be used in such cases.

The 53 patients treated improved greatly and had no further "spells," the doctors reported. They also seem to have been spared the usual progression of their symptoms to a major stroke.

The "spells" which are the warning signals of impending stroke include temporary episodes of loss of control of legs or arms. Brief periods of trouble in seeing, numbness, and confusion are

other signs that may mean a stroke is on its way. Such symptoms, especially the almost momentary confusion, have been called "little strokes."

Laminated blood clots in one of the major arteries to the brain, called the basilar artery, gave a clue to the possibility of preventing strokes by the anti-clot drugs.

Clots found in this artery in examinations after death often had a laminated or layered physical structure, the doctors found. This suggested that the clots had been laid down over an extended period of time, much as a tree trunk grows in width by adding an annual ring.

The doctors reasoned that the layers in the clot probably coincided with the temporary "spells" that often come in step-like fashion as the artery is gradually narrowed by a developing clot or thrombus.

Other patterns of warning symptoms were known to be associated similarly with clots in another major artery to the brain, the internal carotid artery.

Besides the decrease in mortality after the anti-clotting treatment, the doctors reported a surprising amount of improvement in the neurologic abnormalities.

Although they state more study is needed and patients must be carefully selected, they think the

treatment appears to be of great value in certain conditions.

Use of anti-clotting drugs to prevent strokes has been suggested previously by doctors using the drugs in treatment of heart and blood vessel disease.

Probe B Vitamin Role

➤ VITAMIN B-6, known as pyridoxine, might also be called the mystery vitamin, it appears from studies reported at a National Vitamin Foundation symposium at Vanderbilt University School of Medicine.

This vitamin seems to play a definite part in the chemistry of brain and central nervous system activity. But its exact role has yet to be worked out.

Convulsions and other signs of nervous system irritability have been reported in babies and children who were not getting enough of the vitamin.

Brain wave changes appear when there is a gross lack of the vitamin. These changes can be swiftly corrected, with corresponding improvement in the patient's condition, Dr. David Baird Coursin of St. Joseph's Hospital, Lancaster, Pa., reported.

One two-year-old girl who had been operated on for hydrocephalus, or water on the brain, responded within a few minutes to injections of the vitamin. She had been unconscious and did not react to pain, light or sound.

Her brain wave tracings were abnormal.

The brain wave records returned to normal and the baby became wakeful and noticed light and pain within 60 seconds after one vitamin B-6 injection. Then she lapsed back into her former state of stupor. She was again revived by the vitamin and for

several days while getting the vitamin treatment she alternated between periods of wakefulness and unconsciousness. But finally the vitamin had no further effect and the baby got steadily worse.

Dr. Coursin reported her case for its example of brain wave changes in response to vitamin B-6.

Drug Makes Blood Vessels Fragile

► A DRUG that causes hallucinations and other symptoms of mental sickness also seems to make small blood vessels more fragile so that blood escapes from them.

The drug, lysergic acid diethylamide, does this apparently by blocking the effect of another chemical normally present in the body. This second chemical is 5-hydroxytryptamine. The tryptamine chemical had been suspected of acting to prevent escape of blood. But because it presumably is present in the body in plentiful amounts, it was difficult to be sure of this.

Lysergic acid diethylamide had already been found a powerful blocking chemical against 5-hy-

droxytryptamine. So scientists at the University of Edinburgh and the Medical Research Council tested the matter by forcing small amounts of lysergic acid into the skin by an electric current.

Appearance of telltale purple spots in the skin, indicating the escape of blood from little vessels under the skin, showed that the lysergic acid counteracted the 5-hydroxytryptamine and weakened the walls of the small blood vessels, and that the tryptamine, as suspected, has some ability to stop the escape of blood.

The research was reported in the scientific journal, *Nature*, by Drs. E. L. Blair, G. I. C. Ingram, Marvis Wakefield and P. Armitage.

Three hundred gallons of jet fuel are required to taxi a current jet bomber from warm-up ramps to the end of a runway for take-off, generally a distance of about one and a half miles.

A tiny gas generator no larger than a can of soup, designed for guided missiles, develops 850 jet horsepower, more than that developed by three of the largest modern cars.

Mass Trials of Cold Vaccine

by JANE STAFFORD

► A MASS TRIAL of a new vaccine against a special kind of infectious cold is expected to get under way within a year.

It will be something like the mass trials of the polio vaccine summer before last. But instead of grade school children, 5,000 to 10,000 military recruits will be lined up for shots. Still later, college and university students may get their shots of the same vaccine if the Army trials prove it effective.

Special groups of industrial workers are likely to get shots of another, similar vaccine if signs appear among them of an epidemic of eye disease, called "shipyard fever" in World War II.

These are the prospects for the near future in the fight against colds that make eyes red and running, throats sore, glands swollen, and sneezes and sniffles and general misery.

For the sneezing and runny nose kind of cold, scientists need more time to produce a preventive vaccine. But they have them for some "grippe-like" colds and believe they can make them for some others.

The plans and hopes for trial of one cold vaccine among mili-

tary recruits were revealed by Drs. R. J. Huebner, J. A. Bell and Victor Haas of the National Institutes of Health, Bethesda, Md., and Dr. T. G. Ward of Johns Hopkins School of Hygiene and Public Health, Baltimore. This group already has a large pool of vaccine produced for the purpose. Army authorities are enthusiastic, they said. Details of the trials will be worked out as soon as small scale trials to determine safety and dosage are completed. Commercial houses, especially one that has produced polio vaccine, are now working to produce this vaccine.

The vaccine is made from three formalin-killed viruses. They are types 3, 4 and 7 APC viruses. The letters APC stand for adenoid, pharynx (in the throat) and conjunctiva of the eyes. These are the regions from which the viruses have been isolated.

Types 3, 4 and 7 for which vaccine has now been made are the ones that cause a five or six day attack of feverish, grippe-like illness in a large proportion of military recruits. These also cause the grippe-like sickness that hits colleges and universities every year in mid-October.

A vaccine against just type 3 has been tried in prisoner volunteers. It prevented the sickness in about 70% of the susceptible volunteers when the vaccine was "challenged" by doses of live virus swabbed on the eye. Among susceptibles without the vaccine, this "challenge" produced sickness in 94% within two to six days. The vaccine is expected to give even greater protection against naturally caught diseases, since a person is not likely to get such a big dose of virus that way as through the "challenge."

The vaccine caused no reactions among the volunteers, not even a sore arm, though the volunteers would have been sure to report a sore arm in order "to get

off working on the rock pile."

As evidence that the vaccine contains no live virus, the scientists reported that it contains at least 10 times as much virus-killing formalin as "another well known vaccine," meaning the polio vaccine.

Type 3 APC vaccine takes effect within 10 days to two weeks. It probably protects for more than one year, although the scientists do not yet know this for a fact. It is only six months since they first used it. The vaccinated, however, had protective antibodies in their blood for at least two months after. Patients who got the disease in 1951 still have antibodies at a high enough level to be protective.

Tired Feeling is Potassium Lack?

➤ A MARKED loss of body potassium causes that "weak, tired feeling" after an illness.

This is the suggestion of Dr. Joseph Ross of the University of California at Los Angeles Medical Center and Dr. Belton Burrows of the Boston University School of Medicine.

Using tracer atoms of radioactive potassium, the doctors found a marked decrease of potassium in bodies of patients with chronic illness.

Potassium is one of the substances of importance in muscle contraction and strength, the researchers point out. A shortage of

it in the body might account for the weakness and tendency to tire easily that generally follow an illness.

Minute amounts of radioactive potassium were administered to patients in "atomic cocktails." The total potassium content of the body was indicated by the extent of dilution of the radioactive atoms with normal body potassium.

Such measurements enable doctors to recognize potassium deficiency in patients and indicate the amounts of potassium that should be administered to make up the deficit and improve the patient's condition.

Warm Seas May Have
Led To Frigid Ice Age

Ocean Control of Glaciers

► DR. WILLIAM L. STOKES, geologist with the University of Utah, has proposed the paradoxical theory that above average oceanic temperatures made possible the great glaciers that covered the earth in the Ice Age.

According to Dr. Stokes, at least 29 "explanations" have already been put forth to account for the Ice Age, and none have been able to stand up under known facts. He believes his "Ocean-Control Theory" may help furnish the ultimate answer.

Scientists generally agree that the Ice Age was initiated with the uplifting of mountains to great altitudes, changing rainfall into snowfall over wide areas. The Ice Age should end when erosion or other cataclysmic events have worn down mountains. The great question has been, what happens in the meanwhile that accounts for the waxing and waning of the great glaciers of the several subglacial periods? (The world is at present lying between a minimum and maximum period of glaciation, and glaciers seem wasting away.)

For the great glacier sheets to build up, there needs to be high precipitation along with lowered temperatures. But lowered tem-

peratures in the ocean would mean less precipitation. Thus, Dr. Stokes offers the theory that the oceans during the building up of continental glaciers were of relatively high temperatures.

Dr. Stokes accounts for the paradox like this:

The ocean has such tremendous volume that many thousands of years are required to cool or heat it. This lag in response to temperature change allows the ocean to remain warm while cooling influences are at work on land.

Since the ocean remains warm, precipitation stays high adding to the glacier-building snowfall.

After perhaps several thousand years, cold water run-off and cold air begin to lower the oceanic temperatures. This results in less precipitation, and the glaciers begin to wane in size until they reach about their present status, an interglacial period. Thereafter, warm water run-off from the land begins the slow process of heating up the ocean, and the cycle is repeated.

Dr. Stokes repeatedly reminded, in his report of the Ocean-Control Theory in the journal *Science*, that this concept is only a theory, and that it awaits proof by the many tools scientists have

to probe the earth's past. However, he said, the theory does seem to account for most of the known facts about Ice Age formation.

To illustrate his theory, Dr. Stokes started with the present age and carried through to the coming of another glacial period. He said the present time seems to be a time between maximum and minimum glaciation and that evidence points to the fact that present-day oceanic temperatures are much lower than in many other epochs.

Evaporation and precipitation are now relatively low, as is witnessed by current retreating of

glaciers. Polar ice is diminishing at a rapid rate, he said, and it is possible to foresee the time when there will be none at all. There will follow a slow but general warming of the seas, requiring many thousands of years.

Then heavy precipitation from the warm ocean will cause the build-up of a great snow-field, resulting in the chilling of the atmosphere and accelerated building of glaciers. Meltwater from the snow and ice fields will begin to enter the ocean; the polar basins again will fill with ice, and in other thousands of years, the temperature will reach its present state — and the glacier peak will be ended again.

Lighter Glass Jars and Solder

➤ TWO NEW developments in glass research, a lighter-weight glass container and a low temperature glass solder, have been announced at the Owens-Illinois Technical Center, Toledo, Ohio.

The glass container, which is 20% lighter, but still stronger than similar containers, is made by a new method of controlling the transfer of heat from the glass as it leaves the furnace. This process cools the jars rapidly and induces controlled stresses, making the glass many times stronger than ordinary annealed glass.

In announcing the development of a glass solder, Carl R. Megowen, president of Owens-Illinois, stated that color television broadcasting may be expedited by its use. It is now being used experimentally on color television tubes. It is an all-glass solder which has the advantage of giving a permanent seal, but it can be opened and resealed by the application of heat. This enables the working parts of the bulb to be installed or removed for repairs without destroying the bulb.

Two coats of metallic zinc paint will protect zinc or galvanized surfaces from rust for about 10 years.

Chairman AAAS Medical Division
Tells How Tracer Studies Began

Radioactive Pharmaceuticals

by MARSHALL BRUCER, M.D.

Oak Ridge Institute of Nuclear Studies, Oak Ridge, Tennessee

Dr. Brucer regaled his colleagues at the December meeting of the American Association for the Advancement of Science with these delightful reminiscences of early isotope studies, a field in which much has happened in only a few years. He points out the next steps needed to make radioisotope tracers still more useful in medical research.

► AT THE CLOSE of World War II atomic energy was made known to the world with a bang, and radioactivity became a widely known, if little understood, word. Much was promised for this, by then, 50 year old infant. Some scientists predicted that it would revolutionize industry. It hasn't, but industry has revolutionized the use of radioactive isotopes. A few very well known professors predicted that our knowledge would increase a thousand fold. It hasn't, but our knowledge of radioactivity has. One prominent scientist predicted that radioisotopes would cure cancer in ten years. Maybe they will, but the unfortunate patients die before the ten years have passed. Therefore we haven't been able to find out whether this prediction is

true or false. One university president stated that because of radioactivity the human body is now an open book, and that every atom can be tagged and its pathway through the body can be charted. This may all be true, but probably more significant is the statement of a distinguished veteran of a thousand scientific cures, discoveries, and headlines: "These radioactive isotopes are just one more thing to foul up an otherwise clean experiment."

One day in 1936 a young intern was assigned to Dr. John Lawrence's service at the University of California. He was supposed to be working in the field of hematology, which is a clean, quiet, and stable field of medicine. The patients in this field of medicine walk into the hospital, and most of them walk out if not cured at least greatly improved. It is a satisfying field for a doctor. This particular intern, dressed in the white robes of his office, reported on his first day to the Crocker Laboratory to learn the exciting news that he was to be the first to use the new medicine, phosphorus, and would he be so good as to go pick it up at the cyclotron

laboratory. The excitement fell flat since the intern had heard of phosphorus since he was a kid, and there was nothing new about it. However, since it is impossible to account for the idiosyncrasies of California, a somewhat out of the way place that might not have heard of phosphorus previously, he headed for a clean, sparkling, hematology cyclotron laboratory to pick up the phosphorus. When he finally found the "laboratory" he was ushered into a cross between a machine shop and a foundry, and was greeted by a small mongrel dog with diabetes insipidus. While waiting for someone to notice him, the intern sat down on a small lead pot and played with the dog. Suddenly the hum of the cyclotron died down and a voice yelled, "Keep that damn dog away from that pot you're sitting on!"

"Why?"

"That's the radioactive medicine for your patient."

This was Dr. Lowell Erf's introduction to a new kind of drug.

In 1941 Dr. Samuel Seidlin, a New York endocrinologist, met a hyperthyroid patient who did not have a thyroid gland. The patient did have metastases throughout his body from a cancer of the thyroid that was taking the place of the thyroid gland. Dr. Seidlin had read about the California work with a new radioactive io-

dine that was said to behave like ordinary iodine but would give off a radiation that was deadly to any cell that contained it. Perhaps this material would be a method of automatically doing radiation therapy in a disease that was too generalized for X rays. But how to get radioactive iodine? Obviously, if it was made on a cyclotron, then telephone a cyclotron driver. A telephone call to California costs money, so Seidlin called Dr. Evans at MIT. It was cheaper to Boston. He asked if the MIT cyclotron made radioactive iodine. He was told that MIT could do anything that California could do and probably do it better. After a long and detailed conversation about the condition of the neutron flamas decapitance and the problem of target fordumucle feedback, the Boston scientist remarked, "Of course there is a small problem of cost."

"How much does it cost?" asked Seidlin.

"\$1800 an hour," said Evans.

After Seidlin picked himself up off the floor he answered, "Well, send me some."

"How many millicuries do you want?" asked Evans.

Not having the slightest idea of what a millicurie was, Seidlin replied, "Send me a whole hour's worth, naturally."

This was the beginning of the science of radioactive dosimetry.

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Seidlin's patient did not have \$1800. He was a medical indigent. Neither did Seidlin have \$1800. He also was a medical indigent. But he figured it would take a week to deliver the drug, another week to get the bill for it, he could stall for a week, and in three weeks the iodine would be all gone anyway, so they could sue him! This was the beginning of the science of financing radioactive pharmaceuticals.

Many years later Dr. Kurt Stern of New York was confined to his bed with a head cold. He had read all the novels and worked all the cross-word puzzles in the hospital library, so he was avidly digesting the tables of the isotopes. One particular rare earth isotope struck him as particularly useful. He saw that this was an easily produced isotope and he remembered the plea of the AEC that we must and we will find new uses for old isotopes. Ordinarily Dr. Stern is a very rational man, but in his feverish condition he got out of bed and wrote a letter to the only existing producers of isotopes and said:

"Please send me some yttrium isotope."

On official stationery came the prompt reply, "What?"

"Yttrium," he answered.

On official stationery came the prompt reply, "We don't have any."

"It's in your catalog," he answered.

On official stationery came the prompt reply, "Oh!"

"Well, send me some," he answered.

On official stationery came the prompt reply, "You will have to fill out forms 1 through 313."

"Send them," he answered.

On official stationery came the prompt reply, "You must have an Isotope Committee."

So he formed an Isotope Committee.

Then he had his security checked.

Then he went before the Subhuman Committee.

Then he got some pure food and drug forms.

Then he got instructions in filling out an order.

Then he got an order blank.

And many years later he got his first shipment of yttrium, only it wasn't yttrium. The pile people had some extra lanthanum lying around and they sent that instead.

It's much the same thing.

These were the beginnings from which the radioactive pharmaceutical industry was started.

In the short space of 10 years things have changed rapidly and usually for the better. Instead of a few brave research-type characters fooling with things they knew nothing about, nearly 4500 persons are now using isotopes in a fairly routine manner, and they

know a little bit about it. The production of a few millicuries of phosphorus just 20 years ago was a physical triumph. It meant that a brace of physicists had accomplished the impossible again and a celebration was in order. Today over 2,500,000 millicuries of various isotopes are shipped each month, and they are being produced on an assembly line basis.

But the essential developments in the use of isotopes in medicine haven't yet begun to show their potential importance. The best illustration of the lag of our practical applications behind our theoretical knowledge goes back to the early 1920's. Three doctors in Boston, Drs. Weiss, Blumgart, and Yens, were anxious in 1925 to determine the velocity of the blood stream. If they used a measuring tool that tampered with the blood vessels, they changed the velocity. Therefore, it had to be done in a living patient with a vascular system that was intact and untouched during the experiment. They had heard of an isotope of radium that had a short half life and could be absorbed into an innocuous sodium chloride solution. They placed what today would be considered large, cumbersome, and crude radiation measuring instruments over the heart, head, legs, and arms, then injected the radon into one arm in a single

small slug of saline. The instruments indicated rather simply how fast it took for this slug of radon containing saline to get from the arm to the heart, and from the heart to the other stations in the body. They found out what the circulation time was, and although the experiment has been repeated with greater and probably unnecessary precision, it has never been improved upon. It was one of the classic experiments in medicine.

We can now do this experiment using a solution in which the sodium or the chlorine is radioactive in itself. Weiss and Blumgart had to stop with the circulation time because the radon they used was an element foreign to the body and metabolizes over an unknown pathway. When we use sodium and chlorine, the experiment is carried much further into the diagnostic rewards of electrolyte balance studies. But not many physicians are using radiosodium or radiochlorine today. Although the material is cheap, the method now very simple, and the diagnostic rewards great, the reasons for the lag in use are due to problems that rightly belong in the lap of the pharmaceutical industry. A description of these problems illustrates why radioactive pharmaceuticals are somewhat different from other drugs that can be sold over the counters.

Drug manufacturers have pretty well licked the problem of spoilage and shelf life. Radiosodium, however, has a half life of only 12 hours. No matter how brown the bottle, any amount bought on Monday ain't there on Thursday. Radiochlorine has a half life of only an hour. Any amount purchased Monday morning ain't there Monday night. Another illustration is radiogold. It is a remarkable therapeutic agent for some kinds of palliative therapy. It is looked upon with disfavor on the west coast because few people can afford to pay for the wasted decay during transportation. One of the reasons for the popularity of radioiodine is that it has a half life of a week, which is a reasonable time for the mechanics of handling. At the present time Oak Ridge is the main producer of isotopes, and the pharmaceutical industry must work around its facilities. This situation is changing rapidly. Reactors are opening up all over the country and a few of these might be isotope producers. The Government is already out of the cyclotron isotope business because it was obvious that private industry could do the job. It will probably do the same for reactor-produced isotopes if they can be handled by private industry. However, before any sources of isotopes can be successful, the pharmaceutical industry will have

to solve the problems of rapid deterioration and unusual shelf life with better solutions than we now have. This will not take further research. We already know how to do this. However, there will have to be some clever business management if there is to be a radioactive pharmaceutical industry.

There is another feature about the sodium isotope that keeps it from being as useful as it might be. This is another of the problems that will meet the producer of radioactive pharmaceuticals. The sodium isotope gives off a very high energy gamma ray. Although it is true that the pharmaceutical industry is accustomed to handling poisons, the present day answers are not sufficient: A strong bottle, a tight cork, a skull and crossbones stamp, and keeping it out of reach of small children. With radioactive sodium the outside of the bottle is more dangerous than the inside. In order to protect the chemist, the pharmacist, the physician, and the patient, radioactive pharmaceuticals must be stored behind several inches of lead. When one makes a shipment of radiosodium he ships a few pounds of lead, not just a few milligrams of drug. This is not an over-the-counter selling proposition; it is a special handling problem. If there is to be a radiopharmaceutical industry, this is one of

its primary problems. The research needed here is more in the field of business management than in medicine.

One of the very unusual things about radioactive pharmaceuticals is that most of us who are now using them are still calibrating doses. I have never in my lifetime seen a physician measure the amount of morphine in a pill. I have never seen a physician dissolve the carrier out of an aspirin tablet and then, using carefully calibrated instruments, weigh out five grains of acetylsalicylic acid. Few physicians are worried about the exact definition of a milligram. The manufacturer's label on the bottle makes the material ready for human use and questions of accuracy are seldom raised.

Many of us who are now using radioactive pharmaceuticals spend a great deal of time and effort in the standardization of doses, in the measurement of basic units, and in interminable arguments on the techniques of measurement. The most commonly used unit in radioactive drugs is the millicurie, 37 billion disintegrations per second. To make the measurement, one must know the exact manner in which the isotope decays. To determine this exact decay scheme is a formidable physical task. Therefore, the unit millicurie is either unknown or known to be incor-

rect for most isotopes. There is an element of doubt in even the best known isotopes. Before radioactive pharmaceuticals can become very useful to physicians, the basic job of making the pills, filling the bottles, and printing the labels must be taken over by people who are competent to furnish drugs ready for use.

One of the most serious problems confronting a physician who wishes to use an isotope, even when it is a well-recognized procedure, is the maze of forms, regulations, and administrative blocks to its use. There are many good reasons for each regulation and there are just as good reasons for each change that is contemplated for each regulation. But these good intentions do not get the drug to the patient. It is conceivable that a tourniquet around the neck is not a good way to stop a nose bleed.

During the past 10 years the use of radioiodine has increased from a few millicuries to almost 50,000 millicuries per month. Radiophosphorus has increased to a use of almost 13,000 millicuries per month. Radiogold was almost unknown in 1950; now over 50,000 millicuries are being shipped each month. For a drug to change within 10 years from an almost unknown item to the point where its hundred millionth millicurie approaches use is a remarkable development. One hundred

million of anything is a lot, and it indicates that there already is a radioactive pharmaceutical business even though there may not be a radioactive pharmaceutical industry. Radioisotopes are no longer research stunts. In a few

instances they are now the preferred method of diagnosis and the treatment of choice. With very few exceptions all of this has been done without the very necessary aid and backing of a radioactive pharmaceutical industry.

The wonder metal, titanium, is melted to ingots under a blanket of the gas helium which keeps the metal from absorbing harmful gases while hot; many metals are welded under a helium shield for the same reason.



► "ARGYLE, in case this experiment doesn't turn out as I expect, I want you to know it's been nice knowing you!"

We Will Drink the Sea

By WILLIAM GRIGG

► WATER-STARVED communities look hopefully toward the sea for future water supplies. But it will be 10 to 15 years, at the present rate of progress, before they can satisfy their thirsts with fresh water made from the briny deep.

Both houses of Congress have passed \$10,000,000 appropriation bills to keep the U.S. Interior Department salt water research going until 1963. This research, begun in 1952, has made good progress but still has more to make.

For many years scientists have been able to make drinking water from the sea. But they cannot make it cheaply enough for widespread use. Drinking water now being produced in distillers costs ten times the price of ordinary water supplies in most localities.

Even the most optimistic estimates of how much research can further reduce the costs of present processes set the price at twice that of ordinary water.

The still, using the same principle as in making whisky, is one of the methods of conversion. David S. Jenkins, the Interior's director of the Saline Water Conversion Program, estimates that

one form of still, the Hickman, may make pure water at one-fourth the cost of any process now in use.

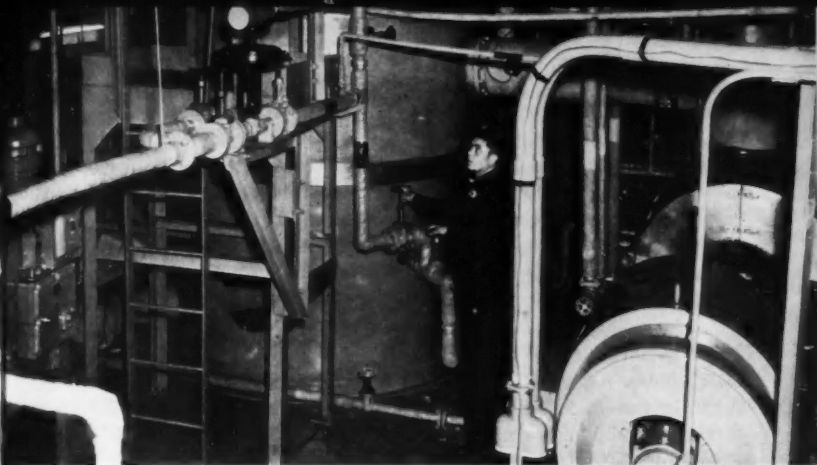
In all conversion stills, salt water is heated until it produces steam. This steam, of course, is salt free, and can be condensed into pure water.

The conventional still creates steam under high pressure to force it into pipes which carry the steam to the condenser. But the greater the pressure the higher must be the temperature to turn water into steam.

To overcome this waste of energy, Dr. Kenneth C. D. Hickman of Badger Manufacturing Company in Boston, Mass., lowers the pressure and uses fans to blow the steam into the pipes. The fans compress the steam, and it is routed, in pipes, through salt water. This cools the steam, and at the same time efficiently heats the salt water.

Dr. Hickman believes he can produce a small distiller that could economically supply fresh water for an individual home beside the sea.

The high cost of fuel used by a still makes it difficult to lower



► *OCEAN WATER is changed to fresh water in this huge distillation plant, developed and tested by the Corps of Engineers at Boston Army Base and now operated at Kindley (U.S.) Air Force Base in Bermuda. Drinking water produced by this plant costs ten times what U.S. communities pay for natural fresh water. But in Bermuda no water is available from rivers or wells; natives must catch rain water in containers on the roof-tops of their homes.*

costs past a certain point. Perhaps atomic power will some day solve this energy problem.

Another answer to high fuel costs comes from Dr. Maria Telkes of New York University. Dr. Telkes is trying to devise practical means to use the energy from the sun.

Solar distillation would not be possible, researchers believe, except in the southwestern United States, where the sun is very strong. It is a much slower method than the Hickman still, and, at present, requires a great expanse of expensive equipment.

All stills evaporate distilled wa-

ter from salty water. The resulting water is free of all impurities, not just salt-free.

For the slightly brackish water abundant in many inland lakes and underground reserves in the U.S., some researchers believe that removing the salt from the water will prove cheaper than evaporating the water. One salt-from-water process attracting a great deal of attention is the electric membrane process. This is how it works:

In water, salt (sodium chloride) breaks up into positively charged sodium ions and negatively charged chloride ions. If a

positively charged electric pole is placed in one end of a pool of salt water, and a negatively charged pole is placed in the other, the poles will attract the chloride and sodium ions, respectively.

The pool is divided into three parts by membranes which enclose each of the electric poles. These membranes prevent chemical changes near the poles from affecting the water in the central part of the pool, while at the same time permitting the sodium and chloride ions in the center part of the pool to enter the area of the electric poles, where they become trapped. Thus, the central area becomes salt-free.

The process has been tested in Arizona, where plugging and sliming proved to be problems. The water used was from a slightly brackish inland supply. Although the conversion cost has not been officially released, it is probably over \$20 per acre-foot.

The use of the electric membrane process with ocean-water supplies would probably cost \$500 per acre-foot. Under Interior Department contract, Ionics, Incorporated of Cambridge, Mass., conducted the Arizona tests. The company produces a line of brackish water demineralization equipment that is for sale for commercial use.

In its research program the Interior Department is acting under

the theory that economic forces, as well as scientific research, will make conversion practical. If underground water supplies continue to drop and U.S. population and industry continue to rise, the demand for water may eventually make even the most expensive conversion method "practical."

The goal of the Interior Department is not to develop conversion methods which could compete on a cost basis with natural water supplies. For municipal and industrial water, the goal is \$100 to \$125 maximum cost per acre-foot (325,851 gallons).

A very few industrial plants in the United States pay almost \$100 per acre-foot for fresh water. Most communities pay between \$1.50 and \$50 an acre-foot.

If put into operation now, large conversion plants employing presently known techniques probably could produce an acre-foot of water from the ocean for between \$150 and \$1,200.

The Pacific Gas and Electric Company's plant on Morro Bay in southern California uses water distilled from the ocean. Although it costs \$500 per acre-foot, this water was cheaper than the company's alternatives: drilling for water or building a dam on a river.

Conversion is "practical" on ships of the U.S. Navy even though the cost is \$1,500 an acre-foot. Solar distillation kits are

standard equipment on Army and Navy life rafts.

Besides investigating the three processes discussed above, the Interior Department plans research on freezing, solvent, membrane-hydraulic, and high pressure-high temperature processes.

The freezing process is based on the fact that salt water loses its salt when it is frozen. Since it takes seven times as much energy to evaporate water as to freeze it, this process might lower fuel costs considerably.

Solvents have been developed which extract fresh water from

brine, but further research is necessary to determine if this could be done economically. Research on a desalting process using membranes and hydraulic pressure is "encouraging," Interior officials report.

The Swedish inventor Baltzar von Platen suggested the high pressure-high temperature process. A critical pressure device using pressures up to 5,000 pounds and temperatures up to 800 degrees Fahrenheit is being investigated by Nuclear Development Associates, White Plains, N. Y.

Viruses are being studied by ripping them lengthwise down the center, by dissolving away specific components, by centrifugally separating light and heavy parts, by freezing and drying and by new microscopic and photographic techniques.

The atomic submarine, Nautilus, uses low-velocity neutrons in its reactor and heat is removed by water under high pressure; the second atom sub, the Sea Wolf, uses higher velocity neutrons and liquid metal to remove the heat.

On the Back Cover

► THE SUN AT WORK was the theme of the Solar Engineering exhibit at Phoenix, Arizona where far-seeing enthusiasts showed the primitive solar heaters, pumps and engines so far developed to make direct use of the sun's energy. With the exception of the photograph on page 3, which was taken by Mrs. Davis, the pictures of the exhibits are from the Phoenix Chamber of Commerce.

For The Home Lab

The Electrochemical Series

by BURTON L. HAWK

► ONE OF THE finest examples of the systematic relationship of the chemical elements to each other is shown in the Electrochemical Series of metals. This Series is merely a list of the metallic elements arranged in the order of their decreasing chemical activity. Suppose we take the familiar metals and list them accordingly:

Potassium
Sodium
Barium
Strontium
Calcium
Magnesium
Aluminum
Manganese
Zinc
Chromium
Cadmium
Iron
Cobalt
Nickel
Tin
Lead
HYDROGEN
Copper
Arsenic
Bismuth
Antimony
Mercury
Silver
Platinum
Gold

You will note that the metals

at the top of the list are exceedingly active, those in the middle are moderately active and those near the bottom are relatively inactive. Also, note that we have included hydrogen in this list. Here it acts as a dividing line. All of the metals listed above hydrogen will liberate it from acids or water; those listed beneath it will not. For example, the metals down to calcium will liberate hydrogen from cold water. The metals from magnesium through iron will liberate hydrogen from boiling water or steam. The metals from cobalt through lead will only liberate hydrogen from acids.

To demonstrate the decreasing activity, prepare a dilute solution of hydrochloric acid and pour equal quantities into five test tubes. Now in the first tube drop a piece of magnesium; zinc in the second; iron in the third; tin in the fourth; and copper in the fifth. Note that the magnesium dissolves rapidly, the zinc fairly rapidly, the iron moderately, the tin slower and the copper is not affected.

Another factor to consider in the Electrochemical Series is the *displacement* of one metal by another. Any metal in the Series will displace from solution any other

metal which comes below it in the list. Thus, a piece of iron will displace copper in a solution of copper sulfate and will itself go into solution as iron sulfate. Copper, in turn, will displace silver from a solution of silver nitrate. Silver will displace gold from solutions of gold salts.

Prepare a solution of copper sulfate and drop a piece of steel wool into it. In a few minutes the wool will be covered with a deposit of metallic copper. You can make a "copper" nickel by dropping a nickel coin in a solution of copper sulfate. Here the action is much slower, as the coin is an alloy containing only a small percentage of nickel.

Drop a piece of clean magnesium in a solution of nickel sulfate. Let stand for a while and then examine the magnesium for the presence of nickel.

The displacement of lead can be demonstrated with the familiar "lead tree" experiment. Dissolve 5 grams of lead acetate in 50 cc. of water and add a few drops of acetic acid. Pour into a beaker and suspend a strip of zinc in the solution. After a short time the zinc will be covered with brilliant crystalline spangles of metallic lead.

Or, perhaps you prefer a "silver tree." Prepare a solution of silver nitrate in a beaker. Place a globule of mercury in a small linen bag and immerse it in the solu-

tion. After standing a few hours, crystals of silver will be displaced and will cling to the bag.

Metallic tin can be isolated by displacement. Prepare a strong solution of stannous chloride. As before, suspend a zinc rod or strip in the solution. Allow to stand for several days when a mossy deposit will form on the zinc. Remove from the solution, scrape off the deposit and dry by squeezing between sheets of filter paper. The deposit consists of minute crystals of tin.

You can use the displacement of mercury by copper to make a "silver" penny. Drop a clean copper penny in a solution of mercuric chloride. After an hour or so remove the coin. To bring out a silvery luster rub the coin briskly with a soft cloth.

You can obtain metallic silver in the same way. This time place the coin in a solution of silver nitrate. (The deposited silver will not cling to the coin as well as the mercury; hence mercury makes the better "silver" penny). Collect the little plates of pure silver after allowing the solution to stand for a few days.

Maybe you have been wondering why this list of metals is known as the *electro*-chemical series, or as the *electro*-motive series. The reason is that the *voltages* shown on the voltmeter decrease down the list when the metals are used as a negative

electrode in a voltaic cell. In all cases, a carbon rod is used as the positive electrode. In other words, the metals are listed in the order of the ease with which they lose electrons.

If you have access to a sensitive voltmeter you may like to try this. Use a very dilute solution of sulfuric acid as the electrolyte and place it in a large wide-mouth jar or beaker. Insert a carbon rod in one portion of the liquid and a metal near the top, such as magnesium or aluminum, in the solution opposite the carbon. Do not allow the two materials to touch each other. Now connect the two electrodes together by means of the voltmeter. Remember, a voltmeter is always connected in parallel with an electric circuit which means that the positive lead should be connected to the positive electrode (the carbon) and the negative lead to the negative electrode (the magnesium or alu-

mium). Note carefully how far the needle is deflected. Now repeat the procedure using a metal further down the list such as iron or lead, instead of the magnesium or aluminum. Observe in this case the needle of the voltmeter is not deflected as far as before which means there is a decreased voltage, hence a decreased current, hence a decreased flow of electrons.

Finally, the electrochemical series tells us how easily the various metals can be obtained. The metals at the top are never found free in nature and hence are isolated only with difficulty. The metals down to cadmium are not reduced by hydrogen. The metals from iron through antimony are isolated with more ease and are readily reduced by hydrogen. The metals below antimony are often found free in nature and are very easily isolated.

Industrial Spider Spins Fine Wire

➤ A MECHANICAL "spider," so precise it feels every slight change in tension of the fine wire it spins, is making aircraft safer to fly. It is a coil-winding machine that spins wire coils for gyroscopes, fuel gauges and other aeronautical controls.

The "spider" spins loops less

than $\frac{1}{25}$ th of a hair width apart at speeds up to 1,500 revolutions per minute.

An electronic machine developed by Minneapolis-Honeywell engineers, it can produce accuracies in spacing wire down to .00000001 of an inch. But nobody has found a use for such fine work.

Salt should be kept before cattle at all times; loose granulated salt or compressed block salt are more satisfactory than rock salt.

Now Find First American
Lived 30,000 Years Ago

Radiocarbon Extends American Past

► GRADUALLY scientists are pushing back the horizon when men first lived in America.

A new radiocarbon dating method with greater precision points to a date 25,000 to 30,000 years ago when man lived in a cave in the Sandia Mountains near Albuquerque, N. M. Previous, less precise methods had yielded a 17,000 to 20,000-year-old dating for the Sandia material.

The dating was not done on remains of man himself but on fragments of the tusk of a prehistoric elephant found in the same layer with remains of human habitation.

Apparently, reasons Dr. Frank C. Hibben of the University of New Mexico, in reporting the new evidence, the Sandia hunter carried back to the cave large sections of the body of the huge animals. The meat was cut from the bones, as is indicated by scars on the bone surfaces. At least occasionally, the hunters brought in portions of the head and skulls, presumably to eat the brain as a delicacy at their feasts and to make use of the ivory tusks in their tools and weapons.

Hence, if the tusks were 25,000 to 30,000 years old, so also was

the man who hunted down the animal.

The dating by the new technique was accomplished at the Harrison M. Randall Laboratory of Physics, University of Michigan, by Dr. H. R. Crane, and reported by him in the same issue of *Science*. It involves converting the organic material of the tusk to carbon dioxide gas and introducing the gas into a Geiger counter. It requires a sample very much smaller than that required by the earlier method that employs a solid carbon sample. Advantage of the new method is that it is possible to use only the organic constituents of the tusk, thus guarding against extraneous carbon.

One possibility, which is, however, most unlikely is that the ancient men who lived in Sandia Cave included in their number some ancient archaeologists who collected and brought home tusks belonging to earlier times. This remote possibility will be checked by dating of other material found at the same level.

Roughly the new date is confirmed by geological evidence. In the Sandia cave were found a number of layers of soil indicating alternating periods of wet and

dry weather with signs of human occupation in the dry levels.

On top is a dry accumulation of recent origin. Archaeological finds indicate sporadic occupations during the last few centuries. Beneath this top layer is a layer of calcium carbonate deposited under wet conditions. Next came a layer containing cultural materials typically Folsom in nature. This layer has been dated as about 10,000 years old. Ten-thousand-year-old Folsom Man was for a long time regarded as the most ancient American.

Then comes a layer of ochre with no signs of human occupation. It is beneath this ochre layer that the Sandia cultural level was discovered. Two charcoal lenses were found in the Sandia level that may have been fire hearths. These layers in the Sandia cave have been related to exterior glacial happenings in the vicinity, indicating that the Sandian level was there about 25,000 years ago.

Finally, below the Sandia level is a layer of sterile clay laid down just after the cave was formed in the Pennsylvania limestone.

New Kind of Flame

► A NEW KIND of flame, orange-red, shaped like a flat disk, and burning without air has been discovered at the department of engineering at Cambridge University, England, and reported in the scientific journal, *Nature*.

Because methyl nitrite vapor was burned in a large glass tube, this new flame, described as remarkable and unexpected by its discoverers, was seen as a bright cone which peeled away from the base of the grayish-yellow flame burning at the mouth of the tube. When the rate of flow of the organic chemical vapor burned in the experiment was cut down, the orange-red glow at the base of the flame traveled down the tube, flattened into the disk shape top-

ped with a faint cone-shaped after-glow, and continued to burn although no air could reach it. It continued to burn after the main flame at the mouth of the tube had been blown out.

Describing the odd new flame as due to chemical decomposition of methyl nitrite, Peter Gray of Cambridge University and A. R. Hall and H. G. Wolfhard of the Rocket Propulsion Department, Royal Aircraft Establishment, Westcott, who reported the experiment, state that its slow rate of travel down the tube makes it the slowest flame known. Similar chemical reactions have been known to give chemiluminescent glow, previous to this discovery, but not flame.

**Protecting One Cell Chemical
May Make Radiation Damage Worse**

Radiation Damage Discoveries

► NEW AND fundamental knowledge of what goes on inside body cells during damaging radiation has come from studies at the University of Rochester (N.Y.) School of Medicine and Dentistry.

Protection of one vital chemical in a cell nucleus, these studies show, may actually cause the damage or make it worse.

This is because the various enzyme chemicals in the nuclei of body cells normally are in balance. Scientists ordinarily think of the destruction of an organism by radiation as due to a "stripping of the gears" which throws the complex chemical system out of balance. One gear, to continue the mechanical comparison, gets to running much faster than the others. This is why the effects of radiation are so much greater than would be expected in terms of the energy involved.

The new findings, however, show that the damaging action may be due to a reverse effect. One enzyme system in the cell nucleus may be protected by its physical relation to other molecules. If it is protected more than the other systems, this may throw them out of gear and thus cause the damage.

The experiments leading to this

new idea were made by adsorbing the vital cell nucleus enzyme, deoxyribonuclease, on cellulose powder. The adsorption of the enzyme on a liquid-solid interface resulted in protection of the enzyme against radiation damage. Other adsorbing substances, such as ion exchange resins, silica gel, "Celite" and bone ash also gave the protective effect.

The studies, by Dr. G. L. Fletcher, now with Distillation Products Industries, Rochester, N.Y., and Dr. S. Okada of the University of Rochester, are reported in the British scientific journal, *Nature*.

Test For Survivors

► A WAY to tell on the first day after an atomic attack which victims would survive and which would die might be developed as a result of studies at the Southwest Foundation for Research and Education and Trinity University at San Antonio, Texas.

The studies were reported in the journal, *Science*, by Drs. Roy B. Mefferd Jr. and Herman H. Martens, now at the Biochemical Institute, University of Texas at Austin.

Body chemical changes related to survival can be detected in

rats within the first 24 hours after total-body exposure to radiation, these scientists found.

The chemical changes are detected by tests of material excreted from the body. Marked differences in both volume of kidney excretion and in various chemicals excreted were found according to whether the animals survived 30, 14 or 11 days.

The chemicals tested included phosphate, creatinine, urea, uric acid, taurine which is an acid from bile, and several amino acids. Some of the changes in excretion of these compounds were apparently common forewarning signs of impending death, the scientists point out.

"An index of survival" might be constructed from further study of these changes, they state.

For example, on day 1 after irradiation, animals surviving only 10 days had the highest phosphate, taurine, creatinine and alanine and the lowest urea, aspartic acid, glutamic acid and histidine.

A group of animals, whether inbred or not, irradiated with an identical dose probably vary widely at the time of irradiation in their relative sensitivity to irradiation and their potential for recovery, the scientists point out. Variations in both genetic background and body type may be the reason.

Some animals survive and some

die, the scientists state. The metabolic (body chemistry) differences among them are detectable within 24 hours.

Free Discussion Urged

➤ FREE AND open discussion of all possible atomic radiation dangers is tremendously important at this time, the president of the American Association for the Advancement of Science, Dr. George W. Beadle, geneticist of the California Institute of Technology, declared in a recent issue of the journal, *Science*.

Taking to task the Atomic Energy Commission for barring Prof. H. J. Muller's paper from the Geneva atomic conference, Dr. Beadle said:

"Many persons will regret the affair, because devious methods appear to have been used to keep Muller off the program because his viewpoint, which happens to differ significantly from that of the commission, was apparently not as fully represented at the conference as most geneticists would have wished.

"We cannot know too soon what are reasonable upper limits of radiation where large numbers of persons are involved," Dr. Beadle declared. "Important precedents are now being established, and it will be increasingly costly and difficult to modify them if they should prove inadequate."

met-
differ-
table

million Dollar Industry
In Less Than Ten Years

Production of Radioisotopes

Part 1.

by A. F. RUPP, Oak Ridge National Laboratory

► IN JUNE of 1946 there appeared a significant article in the magazine *Science*, announcing the availability of radioisotopes from Oak Ridge. From a very modest beginning, the radioisotope program has grown into a business with sales over 1.5 million dollars per year from Oak Ridge National Laboratory alone; and thousands of dollars of additional business is done annually by secondary processors receiving material from Oak Ridge National Laboratory and other production sites in the United States.

The first large reactor (so-called X-10 graphite reactor) was used to produce the first small amounts of radioisotopes for distribution, and in August of 1946 the first shipment (of carbon-14) was sent to Bernard Free Skin and Cancer Hospital, St. Louis, Missouri, for cancer research. Only laboratory-type chemical processing facilities were available for work on radioactive material, but the program was pursued vigorously, and by 1948 the business had grown sufficiently and experience had been acquired to allow the design and construction of a radioisotope processing area.

It may be noted that there has been a steady increase in shipments during the years that the program has been in operation. The radioisotope program in the United States is set up to encourage the processing of materials by commercial laboratories; and it may also be noted that the amount per shipment has grown rapidly in recent years, partly because of a change in the character of the business—from the retailing of small amounts to many users to wholesale-type sales to commercial processors who reprocess and package radioisotopes in smaller quantities for special kinds of uses. The average shipment has grown from 1 to 2 millicuries per package at the beginning of the program to an average of 2000 millicuries per shipment at the present time; however, the average figure is strongly influenced by very large shipments of cobalt-60 for teletherapy made in the last few years—but it is not unusual to send shipments as large as 1000 millicuries of other radioisotopes such as iodine-131 to secondary processors. Many special compounds and devices are made by the commercial processors; for example, the preparation of am-

poules from which the physician can take standardized doses of radioisotopes for diagnostic work is being performed by well-established pharmaceutical houses, long familiar with the practices and requirements of the medical profession. The magnitude of the business by such secondary processors is considerable. In 1954, one such secondary processor made a total of 15,000 shipments, principally to medical and biological users. The total amount of activity in these 15,000 shipments was about 800 curies; however, this activity came almost exclusively from the facilities at Oak Ridge National Laboratory and was sent out in approximately 1000 shipments.

In the flowsheet of radioisotope production operations it will be noted that production centers around the nuclear reactor, although small amounts of certain radioisotopes are now being made on cyclotrons, such as the very important radioisotopes sodium-22, manganese-54, and beryllium-7. Radioisotopes are produced in the reactor by two main processes: irradiation of target materials with neutrons in n-gamma, n-proton, or similar processes, and by the formation of fission products in the reactor fuel. Some isotopes can be made in several ways; e.g., iodine-131 was originally made by irradiation of tellurium, and after the demand exceeded the a-

mounts that could be easily produced by that method, the separation of fission product iodine from uranium fuel was started. After materials are removed from the nuclear reactor either as irradiated targets or as uranium fuel, the next principal step is chemical processing. A wide variety of chemical processes are employed, some of the more important of which are discussed later in this paper. After chemical processing, it is necessary to test the products carefully for identity, radiochemical and chemical purity; tests for sterility or pyrogenic substances are not made, although high standards of cleanliness are maintained during all operations. The preparations are stored, principally those radioisotopes having half-lives of over thirty days. The next operation is dispensing, which is done by remote control facilities. Packaging for shipment is the next operation; radioisotopes are shipped out either in sturdy wooden boxes containing lead shields (designated as "returnable" containers on which the user must pay a deposit and return to the Laboratory) or a newer type "disposable" container which consists of a small internal lead shield surrounded by highly absorbent paper, sealed in a metal container, which is then enclosed in a pasteboard box. The use of the disposable-type container has developed to the point where over 90% of all ship-

ments from Oak Ridge National Laboratory are made in this manner.

All target materials used in the program are carefully selected or purified before irradiation in the nuclear reactor; spectrographic analyses and in some cases activation analyses are made to determine the purity, in addition to the manufacturer's analyses. An effort is made to collect fairly large batches of highly-purified material with known properties for use as target irradiation material. In some cases, when exceedingly high specific activities are re-

quired (e.g., iron-59) and no suitable processes are available for producing carrier-free or unusually high specific activity material, it is necessary to use electromagnetically-enriched stable isotopes as target material. This has proved very successful and very high specific activity iron-59 has been made from iron enriched to 50% in the target atom (Fe^{58}), from the natural abundance of 0.31%. The specific activities obtained are in the order of 5000 millicuries per gram, compared with that previously available from normal iron of only 25 millicuries per gram.

Iodine-131

Iodine-131 is one of the most important radioisotopes distributed in the radioisotope program. It was originally produced by irradiating tellurium in the reactor and then distilling off the iodine (produced by decay of Te^{131}) after dissolution of tellurium in a mixture of sulfuric acid and chromic acid. Millicurie amounts of iodine-131 per batch were made in this way but the growth of the program required large amounts, so the production of fission product iodine from uranium metal was started in 1948. The original small plant could produce approximately 3 curies per batch and was operated from 1948 to 1954. In 1954 a new plant was installed with a capacity

of approximately 25 curies per batch, using 30-60-day irradiated uranium metal available from the graphite reactor. The essential parts of the original I^{131} process were the dissolution of the uranium metal in strong nitric acid, followed by a steam-air distillation of the elemental I^{131} through a condenser where part of the iodine was removed by the condensed liquid, and the vapor was passed through a caustic solution to remove most of the remaining iodine-131; 99.9% of the iodine passing the condensers was removed by the 50% sodium hydroxide scrubbing solution. Part of the iodine comes off promptly during the dissolution of the uranium and accompanies the NO_2 gases

to the condensing and scrubbing sections; the remainder must be distilled out with steam-air sparging, giving large volumes of nitric acid, nitrous acid, water and (from the scrubber) alkaline sodium nitrate-nitrite solution. It is necessary to distill and concentrate the iodine from these liquors, and at the same time remove as much as possible of the contaminating nitrate. This is accomplished by treating the liquors with hydrogen peroxide to oxidize the nitrite, and subsequent distillation of the elemental iodine into a small volume of dilute hydroxide solution. It was found necessary to add small amounts of hydrogen peroxide continuously throughout the distillation in order to obtain good yields.

With the first fission product process, approximately 40% of the iodine passed on through the condensers into the alkaline scrubber. Experiments indicated that it was possible to remove almost all of the remaining iodine by passing the vapors through an efficient bubble-cap scrubbing tower containing very cold water, at about 3°C. In the present plant the condensers, condensate tank and water scrubbing tower are cooled with refrigerated water. Using this technique, almost all of the iodine is captured in a watery solution containing relatively small amounts of nitrous or nitric acid and it is not necessary to

process a large amount of liquid from the caustic scrubber. In addition to this technique, it has been found advisable to introduce a small stream of oxygen at the base of the cold water scrubbing tower to oxidize the nitric oxide (NO) continuously to nitrogen dioxide (NO₂), thus forming relatively pure nitric acid in the scrubbed liquor rather than unstable nitrous acid. The final alkaline scrubber is used only to remove the remaining 1% of iodine from the vapors so that the gases can be passed on to charcoal traps for the adsorption of xenon-133. The gases from the final part of the process are discharged into the area off-gas system where it is passed through precipitrons, filters, and then is discharged through the 250-foot stack to the atmosphere.

The concentrated iodine distillate from the previously-mentioned hydrogen peroxide distillation is about 1 liter in volume and may contain 25-100 curies of I¹³¹. The distillation is conducted through a four-plate bubble cap column which tends to prevent the distillation of the less volatile hydrogen peroxide and nitric acid, thereby giving an almost pure distillate. Nevertheless, it is desirable to repurify this final distillate in glass equipment in order to achieve the extremely high purity required for I¹³¹ used for medical purposes. In the 1948 plant, the

final purification was accomplished by oxidizing the iodine to iodate with potassium permanganate, adjusting to 20% by volume with sulfuric acid, reducing the iodate to the elemental iodine with phosphorus acid catalyzed with a small quantity of hydrogen peroxide, and then quickly distilling the elemental I^{131} . Any nitric acid contamination that was present was removed by a pre-distillation during the acid permanganate part of the cycle, the iodine remaining in the non-volatile iodate form. This procedure worked fairly well for many years, but being a somewhat temperamental procedure, a better one for routine use was desired. This was accomplished very simply by adjusting the liquor to approximately 20% by volume with sulfuric acid, and then distilling the iodine through an eleven-plate, Bruun-type glass fractionating column, collecting the distillate in dilute sulfurous acid, reducing the io-

dine promptly and completely to the iodine form. After filtering through a bacteriological-type filter and adjustment of volume, the pH is adjusted to 9.0 with sodium bicarbonate and the product is removed for analysis and dispensing. Hydrogen peroxide is also used to assist the distillation of iodine in this final procedure; however, the rectifying column effectively keeps the hydrogen peroxide and nitric acid from passing into the distillate. Iodine-131 with no detectable radioactive contamination and of highest chemical purity is routinely produced in this manner. The overall yield in this process, based upon the calculated amount of iodine-131 in the original uranium slugs, is approximately 85%. The yield loss that is incurred is principally in the distillation from the dissolver since 10-15% invariably remains in the uranium solution; subsequent distillations are over 90% efficient.

Carbon-14

The important radioisotope carbon-14 has been produced in a number of ways at Oak Ridge National Laboratory. The first production was from the irradiation of ammonium nitrate solution in a loop in the graphite reactor. Although some very high specific activity material was made this way, the

process was difficult to operate and therefore was used only a short time. Calcium nitrate was then used as target material and this process was continued until 1948, when production of carbon-14 using beryllium nitride target material was started. Beryllium nitride was selected as an ideal target material because of its very

stable nitride and favorable nuclear properties, there being little parasitic absorption of neutrons in the beryllium. The compound also contains approximately 50% by weight of nitrogen, making it a very compact form of target. Large quantities of beryllium nitride of sufficiently high purity have been produced and are being irradiated to produce a continuing supply of carbon-14 of steadily increasing specific activity.

The aluminum jackets that are used to enclose the Be_3N_2 pellets are removed from the irradiated pellets by melting them off in a furnace. The pellets are then dissolved in 65% sulfuric acid and varying amounts of H_2O_2 , and the carbon-containing compounds are swept out of the solution in a stream of highly purified nitrogen gas. A variety of carbon compounds are given off during the dissolution process, the principal ones being methane, carbon dioxide, and carbon monoxide; small amounts of cyanide and miscellaneous organic compounds are also formed. The gases are passed through a bed of copper oxide at a temperature of approximately 750°C ., to oxidize all the carbon compounds to carbon dioxide. Some water is formed by the oxidation of hydrogen compounds and this is removed in a

small trap before the gases are passed to scrubbers containing highly-purified sodium hydroxide solution, $\text{Na}_2\text{C}^{14}\text{O}_3$, which is formed in the solution, is then removed to a box filled with CO_2 -free nitrogen and the carbonate is precipitated with barium hydroxide. The precipitate is carefully washed and dried before chemical analysis and assay. The isotopic abundance of the carbon-14 produced has ranged from about 2% with the calcium nitrate process up to a maximum of 30% with the present beryllium nitride process. Small amounts of carbon are included in the target material and contribute almost all of the excess carbon that is found in the finished product. Tests have been made showing that only very minute quantities of carbon are introduced from the chemical and nitrogen gas used in the process.

Some of the organic compounds in the gas generated during the dissolving of Be_3N_2 can be separated, and experiments have been run showing that the cyanide that is present has an extremely high specific activity. There is very little demand for extremely high specific activity carbon-14, but it is believed that by isolating some of the various organic compounds small quantities of very high specific activity material, approaching 100% abundance, will be obtained.

Phosphorus-32

Phosphorus-32, a radioisotope useful for medical and agricultural research, is made in relatively large quantities. The production capacity of the equipment at ORNL is approximately 6 curies per batch. Because the flux available in the graphite reactor is fairly low, it is necessary to irradiate large quantities of sulfur to achieve the necessary production (by n-p reaction). Kilogram amounts of highly purified sulfur are melted into large aluminum target cans and the temperature of the reactor is such that the sulfur remains molten in the reactor during irradiation; however, the aluminum container is not appreciably attacked. Gas pressure sometimes forms in the cans during irradiation, which has been traced to small quantities of moisture in the cans and organic matter in the target sulfur which react with the molten sulfur to produce hydrogen sulfide. Some effort has been devoted to removing the organic matter by treating the molten sulfur over long periods of time with magnesium oxide, followed by a very fine filtration to remove the organic matter as a tar-like material adhering to the MgO. Almost all grades of sulfur produced in the United States are free from arsenic, so that it is not necessary to be concerned about arsenic

contamination in the final product.

While the first extractions of phosphorus from sulfur were made by the vigorous method of pouring the molten sulfur into boiling nitric acid, this method was used only a very short while and it was replaced by pressure extractions with dilute nitric acid. The first extractors were made of stainless steel and the dilute 0.1 N nitric acid was mixed with the molten sulfur by using a propeller-type agitator. Good yields were obtained, but the mechanical difficulties were considerable and this method was abandoned in 1949 in favor of the present stationary autoclaving method. This consists merely of melting the sulfur out of the target container into a large Pyrex glass tube enclosed in a stainless steel autoclave. Dilute nitric acid is placed on top of the sulfur and the tube closed and the autoclave lid is bolted on. The temperature is brought up to 135° to 138° C., by applying steam to a jacket on the autoclave. The autoclaving is allowed to continue overnight, during which time over 90% of the phosphorus (as orthophosphate) is extracted into the aqueous phase from the molten sulfur. The efficiency and rate of extraction during this process could of course be increased by better agitation, but since it is allowed to extract overnight and

the extraction is accomplished by a minimum of trouble from leakage of radioactive materials out through seals (one of the troubles with the process where power-agitation was used), it is a quite satisfactory production method. After the extraction is completed, the aqueous phase is drawn off and sent to a quartz vessel for the first step of the purification process; evaporation to reduce volume and destroy organic matter by boiling with aqua regia. The glass tube in which the extraction was accomplished is slightly tapered so that a small rod may be placed in the molten sulfur and then upon cooling, the hard sulfur cake can be lifted from the tube for easy disposal.

During the purification process, the main problem is to separate the microgram quantities of P^{32} (as phosphate) away from the accompanying impurities, which are sulfuric acid from oxidation of sulfur, corrosion products such as iron, chromium, nickel, impurities extracted out of the sulfur which consist of organic matter, magnesium, aluminum, potassium, sodium, lead, and many other trace elements. During the evaporation and the original treatment with aqua regia in the quartz evaporator, much of the organic matter is destroyed. Water is added and the acidity is adjusted to as low a point as possible, and still allow complete removal of

the phosphorus from the walls of the evaporator. The solution is passed through a cation exchange bed (Amberlite IR-120) to remove the bulk of the iron, chromium, nickel, and other cations. The phosphate-containing liquid in the effluent is then put in a precipitator of the Stangreactor type. About 300 milligrams of lanthanum is added as carrier, and by adding ammonium hydroxide, lanthanum hydroxide is precipitated, carrying with it all the P^{32} , possibly as lanthanum phosphate; sulfate and other anions are left in solution. The precipitate is washed and then dissolved in dilute nitric acid and passed through another cation exchange column to remove the lanthanum. The effluent then contains only nitric acid and the P^{32} as phosphate. A small amount of phosphate, 25 micrograms per millicurie of P^{32} , is usually added in the evaporator to cut down losses by absorption during the process. The dilute nitric acid containing the phosphorus is passed to the final evaporator, made of Vycor (96% SiO_2) glass, evaporated to dryness, and dissolved in 0.1 N hydrochloric acid. In order to remove any further traces of cations that might be present, the solution is again passed through a very small cation column containing Amberlite IR-120 resin, evaporated to near dryness, dissolved in 0.1 N hydrochloric acid,

and passed through a small bed of highly-purified activated carbon.

The product is then diluted, analyzed and assayed for dispensing.

Sulfur-35

Sulfur-35 is produced by irradiation of chlorine-containing compounds and at Oak Ridge National Laboratory the compound that has been used since the beginning of the program is potassium chloride. Several other important radioisotopes are obtained by irradiation of the same target material; e.g., chlorine-36 is produced by n-gamma reaction on chlorine-35. Since the radioactivity of the potassium-42 produced by n-gamma reaction with potassium is short-lived, it can be allowed to decay out before the target is processed. Small amounts of phosphorus-32 are also produced by n-alpha reaction on the chlorine.

The target (KCl) is dissolved in water, usually under carefully-controlled conditions so that the small quantity of stable argon-38 which is captured within the crystal can be salvaged when it is released as the crystals dissolve. During our first work on this procedure, it was thought necessary to oxidize the sulfur by adding small quantities of bromine or other oxidizing agents to the solution. It was later found that the sulfur is oxidized to sulfate without the use of oxidizing agents, presumably because it is present in the irradiated crystal in a high-

ly-active chemical form. In the next step, the solution, properly adjusted for concentration, is passed through a column containing cation-exchange resin, Amberlite IR-120, and the potassium is quantitatively removed. The effluent contains hydrochloric acid and carrier-free sulfur-35 in the form of sulfuric acid, which is continuously passed to a small evaporator where the HCl is distilled off under a slight vacuum. The distillation is carried to dryness and the sulfur-35 that is found absorbed in the walls of the flask is removed by boiling with a small quantity of 0.1 N hydrochloric acid. With the exception of small traces of phosphorus-32, the radiochemical purity of the resulting product is quite satisfactory. The traces of phosphorus-32 are either allowed to decay out, or are removed by passing the starting KCl through a column of aluminum shavings, which selectively takes up traces of phosphate. HCl^{36} is further purified by distillation through a small rectifying column, hydrochloric acid being collected as its constant boiling mixture at 20% strength. The specific activity of the resulting sulfur-35 is quite high-carrier-free— for all practical purposes.

Inventions of Chemical Interest

Order copies of patents by patent number from the Commissioner of Patents, Washington 25, D.C., enclosing 25 cents in coin, money order or Patent Office coupon for each. Do not send stamps.

Sulfur From Gases

➤ BY SLOW cooling and then rapid cooling, sulfur can be recovered from hot gases. Particularly designed for small plants that do not warrant the conventional scrubbing methods to recover sulfur from sulfur-containing gases, saving elementary sulfur can be achieved with a water condenser.

Invented by John W. McCarthy of Bartlesville, Okla., the recovery process uses the condenser in such a manner that heat is slowly removed from a gas stream in the portion of the condenser above the water level. This prevents sulfur fog. When a good proportion of the sulfur has been removed, all but five percent of the remaining sulfur in the gas can be condensed by rapidly cooling the gases to a temperature of about 280 degrees to 320 degrees Fahrenheit.

In addition, Mr. McCarthy points out, by operating the water condenser according to his inven-

tion, one can produce enough high temperature steam to operate the sulfur recovery plant itself. Recipient of patent No. 2,708,983, he assigned the patent rights to Phillips Petroleum Company, a corporation of Delaware.

Wool-Like Finish

➤ COTTON, linen and viscose rayon can be made to look and feel like wool.

A process has been invented that permanently alters the chemical structure of the fabrics' cellulose to give it the warmth of feeling exhibited by woolen goods.

Effective on all weights and constructions of cellulose, the finishing process gives to the material a substantial degree of crease resistance that withstands repeated washings.

To effect the woolen finish, cotton fabric is first impregnated with an aqueous solution of orthophosphoric acid and urea, and heated. A cellulose-acid-nitrogen complex results. The fabric is then treated with caustic soda under conditions that provide for a second reaction in which the sodium replaces nitrogen in molecules of the complex. The excess soda is washed out and the fabric

shows its altered characteristics.

Invented by Raymond S. Babi-
arz and the late William P. Hall
of Wilmington, Del., the finishing
process can be applied over an
entire area, or in limited areas
to effect stripes or patterns. It
was awarded patent No. 2,709,638
and the rights were assigned to
Joseph Bancroft & Sons Company
of Wilmington.

Storing Dehydrated Vegetables

► DEHYDRATED vegetables con-
taining natural fats can be kept in
storage for at least three months
without becoming rancid if treat-
ed by an invention that earned
patent No. 2,709,657.

The storage life of dehydrated
vegetables can be markedly in-
creased, state Tod W. Campbell
of Orinda and Galvin M. Cop-
pinger of El Cerrito, Calif., by
stabilizing the natural fats in the
vegetable tissues. To achieve this,
the two government scientists
have perfected a process whereby
the vegetables are sprayed with
an antioxidant, such as benzoic
acid derivatives. The antioxidant,
they claim, if dispersed through-
out the tissue matter prevents the
chemical reaction that causes the
bad odors and flavors associated
with rancid vegetable matter.

In tests made with dehydrated
potatoes, treated potatoes showed
no signs of spoilage after three
months, whereas untreated dehy-
drated potatoes became rancid
after only three weeks. The two

inventors assigned the patent
rights to the United States of
America as represented by the
Secretary of Agriculture.

To Plate Aluminum

► CLEANER-LOOKING, better-pro-
tected airplanes are the promises
of a process for plating aluminum
with cadmium. The plating pro-
cess overcomes imperfections en-
countered since the late 1800's,
report its inventors.

Designed primarily for military
equipment which has a high rate
of plating failure, such as peeling,
the cadmium plating process is
the invention of Merle L. Ihrie
and Floyd A. Root of Sidney,
N. Y.

Effective in adhering to either
aluminum or aluminum alloy pro-
ducts of any shape and size, the
cadmium finish calls for 18 steps.
These include cleaning and etch-
ing the aluminum body, plating
it with zinc, plating it electrolyti-
cally with one of a group
consisting of nickel and copper,
electrolytically plating the body
with cadmium, coating the body
by immersion in a chromic acid
bath and drying the plated ob-
ject by baking it.

The inventors, who assigned
the patent rights to the Bendix
Aviation Corporation of New
York, claimed that their process
prevents blistering and produces
a cadmium finish of uniform lus-
ter. The process was awarded
patent No. 2,709,847.

Semiconducting Alloy

➤ AN ALMOST all-weather alloy for use in transistors and rectifiers has been invented. Composed of aluminum antimonide and gallium, the semiconducting alloy has a better energy band separation and is easier to make than either silicon or germanium.

The combination alloy, produced by three Ohio inventors, has been found to resist oxidation or deterioration in humid environments better than aluminum antimonide when used alone, is useful at high temperatures, has an increased resistance to corrosion by either oxygen or water, and can be made at temperatures of less than 1100 degrees Centigrade.

Assigned patent No. 2,710,253, the alloy's inventors, Robert K. Willardson, Harvey L. Goering and Arthur E. Middleton of Columbus, Ohio, assigned the patent rights to the Battelle Development Corporation of Columbus.

Hydrazine Manufacture

➤ TWO SCIENTISTS at Ohio State University received a patent for a new method for the preparation of hydrazine, the wonder chemical used in rocket fuels.

A series of discoveries by Drs. Harry H. Sisler and Robert Mat-tair of Columbus, Ohio led to the

synthesizing of anhydrous hydrazine through the chemical reaction of anhydrous chlorine and anhydrous ammonia. An important feature of their process is the use of pressure and heat to increase the yields of hydrazine.

A by-product of the invention which earned patent No. 2,710,248 is a new method for the preparation of chloramine, an intermediate product in the hydrazine manufacture used in the preparation of antiseptics. The scientists assigned the patent rights to the Ohio State University Research Foundation of Columbus.

Pump For Nuclear Reactors

➤ IN THE COMING age of electric power from the atom, nuclear reactors of the liquid-metal variety may use an electromagnetic pressure gauge now patented. It was invented by Leonard B. Vandenberg of Sharon Springs, N. Y., who assigned his rights on patent No. 2,710,538 to the U. S. Atomic Energy Commission.

The pump makes use of the electrical conductivity of a liquid metal to indicate pressure, either for measurement or control. The pressure is shown by the amount of current required to maintain a pressure equal and opposite to that being measured.

Humans have two kinds of marrow in their bones, red and yellow; in youth they are found in about equal quantities, but with age the percentage of yellow marrow increases and of red marrow decreases.

Book Condensations

CHEMICAL PROPERTIES OF ORGANIC COMPOUNDS: An Introduction — Elliot N. Marvell and Albert V. Logan — *Wiley*, 326 p., illus., \$4.75. Presenting the college student with an understandable approach to the fundamental principles of organic chemistry.

SCIENCE TEACHING IDEAS II — Abraham Raskin — *National Science Teachers Association*, 47 p., illus., paper, \$1.00. Science teachers exchange ideas.

CHEMISTRY OF THE SOLID STATE — W. E. Garner, Ed. — *Academic Press*, 417 p., illus., \$8.80 Presenting the facts and theories concerning the solid state in a form useful for physical chemists.

AN INTRODUCTION TO PAPER ELECTROPHORESIS AND RELATED METHODS — Michael Lederer — *Elsevier*, 206 p., illus., \$7.75. Describing the various methods at present available and explaining the principles so that you can develop your own separation method.

FUNDAMENTALS OF RADIOBIOLOGY — E. M. Bacq and Peter Alexander — *Academic*, 389 p., illus., \$6.50. Although much remains to be learned in this field, it has already been found that an incredibly small amount of energy can change the life of a cell, a tissue or even an entire organism.

SCIENCE AND CIVILIZATION IN CHINA: Volume I, Introductory Orientations — Joseph Needham with the research assistance of Wang Ling — *Cambridge University Press*, 318 p., illus., \$10.00. Tracing the early beginnings of science in China and the first interchange of ideas between China and the West.

WORLD DEVELOPMENT OF ATOMIC ENERGY: With Special Supplements on U.S. Bilateral Agreements and the U. N. Geneva Conference — Oliver Townsend and J. Robert Barlow, Eds. *Atomic Industrial Forum*, 151 p., illus., paper, \$5.00. Answers to a questionnaire sent over the world in an attempt to obtain a complete survey of non-military uses.

CATALYSIS: Volume II Fundamental principles (Part 2) — Paul H. Emmett, Ed. — *Reinhold*, 473 p. \$12.00. Completing the presentation of fundamental catalytic principles in this series that is attempting to summarize all that is known in regard to the theory and practice of catalysis.

THE WHY OF THE TEXTILE STANDARDS — Jules Labarthe — *Mellon Institute*, 4 p., paper, free upon request direct to publisher, 4400 Fifth Ave., Pittsburgh 13, Pa. A series of three short articles on why textiles sometimes disappoint consumers.

Proudly Presented

► THREE REPORTS of Armed Forces research in the field of ceramics have just been released to industry through the Office of Technical Services, U. S. Department of Commerce. These reports are briefly described below:

A Study of Piezoelectric Elements for the Measurement of Transient Forces. California Institute of Technology for U. S. Army Ordnance and U. S. Air Force. Feb. 1955. 30 pages, illustrated. (Order PB 111702 from OTS, U. S. Department of Commerce, Washington 25, price \$1.) A survey of the suitability of various piezoelectric crystals for measurement of transient forces. The advantages of recently-developed ceramic elements over natural crystals for the measurement of normal forces and volume expansion are also shown. Tables showing the properties of various crystals for measuring normal and shear forces are presented.

Control Methods of Chemical Analysis of Barium Titanate. Naval Research Laboratory. Aug. 1955. 25 pages, illustrated. (Order PB 111780 from OTS, U. S. Department of Commerce, Washington 25, price 75 cents.) As a part of an effort to improve the quality and reproducibility of BaTiO_3

ceramics, a procedure for analysis of BaTiO_3 for both major and minor constituents is presented. Gravimetric and volumetric analysis is used for the major constituents and the principal minor constituents. Flame photometry is used for minor constituents which are particularly difficult to analyze by more normal procedures. Spectrography is used for less common minor constituents.

Color Centers in Calcium Fluoride Crystals. Massachusetts Institute of Technology for Office of Naval Research. Sept. 1954. 18 pages, illustrated. (Order PB 111724 from OTS, U. S. Department of Commerce, Washington 25, price 50 cents.) Synthetic calcium fluoride crystals of various quality were colored by 2.5 Mev electrons, calcium vapor, and low energy electrons, and impurities and imperfections were compared. The best crystals show good transmission in the near and far ultraviolet, high density, low ionic conductivity, and have a low yield of color centers. Four absorption bands were observed in the best crystals, and it was concluded that these bands are caused by electrons and holes trapped in lattice imperfections and not by chemical impurities as has been suggested.

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